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PENSIONS AND WAGES:
AN HEDONIC PRICE THEORY APPROACH

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ABSTRACT

This paper examines whether a tradeoff exists between the level of pension benefits and wages for comparably skilled workers. The 1983 Survey of Consumer Finances is used to match detailed information on pension plans to detailed personal characteristics of a random sample of the population. The pension wage tradeoff is estimated using both a life-time or contractual model of the labor market and the spot market model used in previous studies. The results indicate a large negative tradeoff in the contractual model but only a negligible tradeoff in the spot market model. Results from estimating the underlying structural supply and demand equation for pensions are also presented.

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I. Introduction

There is a vast and growing literature in labor economics and finance that has examined the importance of pensions for a variety of labor and capital market phenomena. The growth of this literature coincides with the growth of pension benefits: pension costs have risen from 1 percent payroll in 1950 to 4.5 percent in 1988, providing coverage for about 50 percent of private sector workers, and over 80 percent of public sector workers. The value of pension assets has also risen dramatically so that by 1986 the ratio of private pension assets to GNP was .32 percent, up from .15 percent in 1970. Private pensions also accounted for 13 percent of all financial assets in 1987.[1] Despite the proliferation of the analyses of pension issues, an area that remains a puzzle to economists is to what extent has the growth in pension benefits been offset by reductions in wages or other compensation. If pension growth has come at the expense of wage growth, then workers can be said to pay for changes in the value of their pensions, as standard equalizing difference theory predicts. If pensions do not represent a compensating differential then their growth has numerous implications for the distribution of income, the burden of pension reform legislation, and issues concerning the efficiency of labor markets.

In this paper we attempt to test whether a tradeoff exists between the levels of pension benefits and wages for comparably skilled workers. Despite the difficulties of estimating compensating differentials models, we use a new data set and estimation technique and find a very significant negative pension-wage compensating differential for a random sample of workers with defined

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[1]See <u>Trends in Pensions</u> (1989).

benefit pensions.[2] Previous work has had little success in finding a significant pension-wage tradeoff and those that have did so only in the public sector or in small unrepresentative subsamples of firms. For example, Schiller and Weiss (1980) estimate the tradeoff for five different age groups using data from the Social Security Administration LEED file and Labor Department data on pension plans at 133 large firms. Only one age group, 45-54 year-olds, have a significant negative tradeoff -- all others were insignificantly negative or positive.[3] Negative tradeoffs were found by Ehrenberg and Smith (1981) but for public sector workers which face different labor markets than private sector workers.[4]

There are a number of important ways in which this study differs from previous work. First, we use a much more complete data set. The 1983 Survey

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[2] The greatest difficulty in estimating compensating differentials models is in modelling unobserved worker productivity. Brown (1980) attempts to control for unobserved productivity by differencing the data and finds little evidence of equalizing differences. Another difficulty is the inability to control for observed and unobserved job characteristics so pensions may be correlated with omitted job characteristics that will bias the pension coefficient. Obviously, no data set can completely overcome this and thus it continues to be a limitation of this study.

[3] See also Smith and Ehrenberg (1983) who use data provided by Hay Associates on 200 firms, and correct for technical simultaneity bias but still fail to find a significant negative relationship. Moore (1987) finds a negative tradeoff when using data from a sample of five large firms but only after instrumenting for pension endogeneity. Bulow and Landsman (1983), who use data on Stanford University faculty, and Mitchell and Pozzebon (1986), using the Survev of Consumer Finances, find a positive relationship between wages and a binary variable representing pension coverage.

[4]Smith (1981) uses data on 1976 Pennsylvania non-uniformed government workers in defined benefit plans and finds a dollar-for-dollar tradeoff between average levels of wages and current pension benefits. Ehrenberg (1980) uses 1973 data on police and firefighters and finds entrance pay and maximum earnings inversely related to the ratio of pension benefits to earnings only for the police. However, a subsequent test in the same paper, using 1974-75 data on police, firefighters and sanitation workers, does not provide evidence of such a tradeoff.

of Consumer Finances (SCF) matches detailed information on pension plans to detailed personal characteristics of a random sample of the population. No previous research on the pension-wage tradeoff has had a random sample of data containing both individual worker characteristics that determine productivity (like education and occupation) and detailed pension plan information that can be used to calculate the expected value of pension benefits. Second, we estimate the pension-wage tradeoff for both the contractual or lifetime model of the labor market and the spot market specifications used in previous studies. We find a larger negative tradeoff over the lifetime than for annual values of wages and pensions. This result is consistent with the large body of empirical and theoretical evidence that the volatile annual changes in pension accrual values are not matched by equally volatile annual changes in wages. Third, we estimate a structural hedonic model of the supply and demand for pensions. By going beyond the standard estimation of the pension-wage tradeoff, we are able to draw inferences about the differential values workers and firms place on pensions, substantiating the theoretical foundations of the hedonic model. This examination of the underlying demand and supply functions could be of value to those interested in the implication of recent tax law changes on workers demand for pensions or for understanding the relationship between firm growth and the supply of pensions.

The structure of the paper is as follows. The hedonic model is presented in section II and its application in the lifetime and spot market contexts is described in section III. The empirical results for the lifetime and spot models are in section IV and the conclusions follow.

II. The Structural Hedonic Model of Compensating Differentials

The hedonic model of compensating wage differentials suggests that jobs often have non-wage benefits, such as pensions benefits, that workers and firms value differently from wage benefits. For example, older workers, or those in high marginal tax brackets, or those with low rates of time preference may prefer to receive a significant portion of their compensation as pensions. Figure 1 graphs indifference curves representing these pension versus wage preferences.[5] The worker who has a preference for pensions would be represented by indifference curve B, because he is willing to give up greater amounts of wage income in exchange for an increase in pension income. The convexity of the indifference curves represents the standard diminishing marginal utility of goods, as well as the effect of the progressive income tax structure.

On the firm side, profit maximizing firms hire labor up to the point at which marginal cost equals productivity. In a simple competitive model of the labor market, firms should be indifferent between offering wages versus pension benefits, as long as the total compensation is the same. As shown in Figure 1, this implies that the isoprofit curves of firms have a slope of -1.

The hedonic price equation (HPE), or equilibrium market locus, is the function tracing out the tangencies between the individuals' indifference curves and the firms' isoprofit curves. In Figure 1, the linear isoprofit curves produce an HPE that has a slope of -1. If the firms' isoprofit functions were

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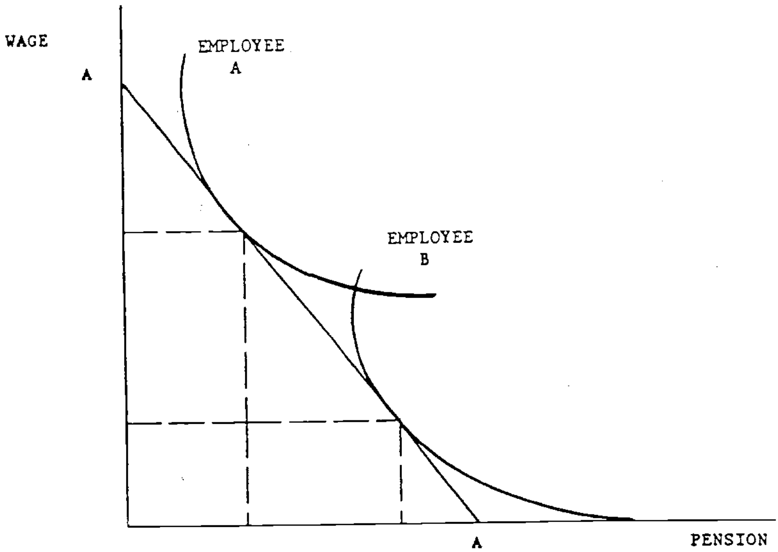
[5] As wage income increases it places individuals in higher marginal income tax brackets, increasing the marginal benefit of pensions, because pensions are taxed upon retirement when income tax brackets are likely to be lower. For a more detailed discussion of the hedonic model, see any standard textbook, such as Ehrenberg and Smith (1988).

FIGURE 1



not linear, a nonlinear market locus would result. Nonlinear isoprofit curves might arise if the implicit price to the firm of a dollar of pension benefits is different than the implicit price of a dollar of wages. For instance, if pensions raise workers' productivity the slope would be flatter. Previous research has suggested a number of ways pensions may raise productivity: by lowering turnover costs as workers quit less, by increasing work effort on the part of the employee for fear of termination of employment and loss of return on firm-specific investments, and by serving as a signalling mechanism to attract more able workers.[6] Thus, the slope of the HPE may fall between 0 and -1, or the pension-wage tradeoff may be less than one-for-one.[7] With heterogeneous firms and workers, the actual slope of the HPE depends on the matching of workers tastes and firms isoprofit functions where workers with high tastes for pensions will tend to be employed at firms with the lowest implicit cost of producing pensions.

To estimate the market wage-pension tradeoff, or the HPE, we follow the functional form of Smith and Ehrenberg (1983), that sets compensation equal to worker productivity:

(1) $W_{it}(1+bp_{it}) = A \exp(X_{it}B + e_{it})$

where W is wage income, p is the ratio of pension income to wage income, X is a vector of factors influencing individual worker productivity, e is an i.i.d. error term, and productivity is distributed exponentially with technology shifts parameter A (based on the strong empirical support of log-linear wage equations). The coefficient b will equal one if there is a one-for-one pension-wage tradeoff. Taking natural logs and assuming that $\ln(1+p)=p$ for small values of p (and suppressing ln A in the constant term contained in X), the market HPE to be estimated is:

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[6] Pensions may also lower productivity, by increasing absenteeism because pensions are independent of hours of work.

[7] Another reason for a slope in this range is that, as Allen and Clark (1987) suggest, if pension plans are underfunded the calculated pension benefit may overestimate the short run cost of the plan.

(2) $\ln W_{ii} = X_{ii} B - b p_{ii} + e_{ii}$.

The market HPE is the locus of points that set the marginal rate of substitution for wages and pensions equal to the marginal cost of pensions -- the underlying supply and demand equations provide information on the valuations for individual firms and workers. For simplicity, express the structural demand and supply equations in linear Marshallian form:

(3) $p^d_i = a_0 + a_1 q_{1i} + a_2 X_{1i} + e_{1i}$

(4) $p^s_i = c_0 + c_1 q_{2i} + c_2 X_{2i} + e_{2i}$

where p_i is again the pension-wage ratio, q_i is the implicit price of pensions, X_{1i} and X_{2i} are the individual and firm characteristics that determine tastes for pensions and costs of pensions, and e_{1i} and e_{2i} are stochastic error terms. The implicit price of pensions faced by workers and firms, q, is the pension-wage tradeoff, or the slope of the HPE.

To estimate the structural supply and demand equations as a function of q, (3) and (4) must be imbedded in a system of equations that includes the HPE that contains q. The identification of such a system is difficult, because it requires that the implicit price in the HPE be a function of variables not in the structural demand or supply equations.[8] We follow the method of identification suggested by Kahn and Lang (1988) and use data from different markets to identify the HPE. Multimarket data provides information on the effects of shifts in supply or demand across markets that are independent of the underlying supply or demand curves in a market. Despite the fact that there may

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[8] Rosen's (1974) early two-step procedure, of estimating the HPE, solving for q_i and substituting into the demand and supply, will not have sufficient instruments to identify the supply and demand parameters.

be multiple dimensions (e.g. skill and location) along which the labor exchange is segmented into separate markets, Diamond and Smith (1985) note that not all multimarket data will be suitable for identifying these equations. The worker or firm choice of market must be exogenous to the pension-wage choice, so that at least some of the determinants of market location do not enter the structural supply or demand equations. We explore several alternatives but focus initially on the labor markets segmented by industry. That is, we assume that the supply and demand equations for pensions are invariant across industries, but that there are differences in the distributions of worker or firm characteristics such that the HPE varies across industries. Thus, the process of matching worker and firm preferences for pensions results in different implicit pension prices by industry.

Our hedonic price equation can be written

$$(5)\quad \ln W_i = .5\beta_1 D_{1i} p_i^2 + \beta_2 D_{1i} p_i + .5\beta_3 D_{2i} p_i^2 + \beta_4 D_{2i} p_i + .5\beta_5 D_{3i} p_i^2$$
$$+ \beta_6 D_{3i} p_i + .5\beta_7 D_{4i} p_i^2 + \beta_8 D_{4i} p_i + .5\beta_9 D_{5i} p_i^2 + \beta_{10} D_{5i} p_i$$
$$+ .5\beta_{11} D_{6i} p_i^2 + \beta_{12} D_{6i} p_i + X_{1i} B + e_{it}$$

where the D_k, k=1...6, are the dummy variables for six industry markets. To consistently estimate the system of equations (2)-(4), we estimate the HPE (5) to get estimates of the β's. Equation (5) can then be substituted into (3) and (4) by replacing q with its reduced form from (5). Given the estimated β's from (5), the a's and c's of the demand and supply equations are consistently estimated with nonlinear least squares.[9] Finally, the efficiency of the estimation is improved if we explicitly recognize the interactions with the HPE:

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[9] Because of the heteroskedastic nature of the reduced form error terms of (3) and (4), these are estimated by weighted least squares as suggested by Kahn and Lang (1988).

individual workers choose jobs taking the market locus as given and individual firms determine supply taking the market locus as given. Thus, we also estimate (3) and (5) and (4) and (5) by weighted three-stage nonlinear least squares.

III. Lifetime and Spot Market Models

All previous research on the pension-wage tradeoff has been done in the context of an annual spot market model of compensating differentials. That is, the pension-wage tradeoff is estimated for annual wage income as a function of the annual accrual of pension benefits (the change in the expected present value of pensions between time t and t-1). In this "spot market" model of compensating differentials, an increase in pension costs must be concurrently offset by a reduction in wage costs for competitive "spot" labor markets to clear.

Given the stylized fact that incremental pension accrual values are far more volatile over the lifecycle than is wage income, it is hardly surprising that these spot market models have not performed very well. For example, Kotlikoff and Wise (1985) report that a typical pension could have a 29 percent spike in pension value the year that the pension is vested and a 30 percent annual drop in value following the year of potential early retirement. There is little evidence that wage income is that volatile, or that wage income falls by 29 percent the year that the pension is vested. Thus, these variables are unlikely to be related at the high frequencies implicit in the spot market formulation used in previous work. Rather than reject the hypothesis of compensating differentials based on these tests, it would also be useful to investigate whether within the long term or lifetime context workers and firms do produce a compensating tradeoff between the expected present values of wages and pensions. Since there is a good deal of evidence that workers and firms do form very long-term attachments (Hall 1982), such a test would seem appealing.

There are several formulations of lifetime implicit contracts in the literature that have implications for the nature of the pension-wage tradeoff. In models of firm-specific human capital, workers and firms share the investment costs and returns. This produces a long-term attachment of the worker to the firm, because after the investment period, the worker's current productivity will exceed his alternative productivity. Given a shared investment by the firm, it may be in its interest to reduce the worker's quit rate by offering wages below marginal product in the first period and above productivity in the second (Carmichael, 1983; Ohashi, 1983). Workers are willing to enter into these contracts as long as lifetime compensation is at least as great as in the alternative, assuming that the reputation of the firm is sufficient to enforce the contract. Under these types of contracts workers may contribute excessively to pensions when young, through lower wages prior to vesting, given their expectation of receiving higher wages and pension benefits later. There would still be an observed pension-wage compensating differential, but it would occur over the expected tenure on the job rather than annually as in a spot market context. Lazear (1979, 1983) suggests delayed payments scheme may be optimal in a world without firm-specific human capital as a means to reduce shirking. In his work, wages are below marginal product when young and exceed it when old, and include the possible skewing of pension benefits to later years and pension costs to earlier years.[10]

These implicit contract models suggest that it is not necessary that wages and pensions equalize annually in competitive labor markets, and that pensions can serve an important function in reducing turnover or shirking.[11] Further, the lifetime compensating differential need not be one-for-one to the degree pensions increase worker productivity by reducing shirking. Thus, in comparing two workers with observationally equivalent productivity variables, the worker with the pension may earn more in lifetime compensation because his unobserved productivity is higher. Our empirical results will explore the magnitude of the tradeoff for both the lifetime and the spot market models.

IV. Empirical Results

The 1983 Survey of Consumer Finances collected extensive data on a nationally representative sample of households. The survey sample consists of 3824 randomly selected households and 438 high-income households drawn from the Internal Revenue Service files. Of this total, 1066 households were matched to the Pension Provider Survey (PPS), which surveyed pension providers for those

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[10] For a review of self-enforcing incentive contracts that include contingent payments, like pensions, see Carmichael (1989). Carmichael claims that pension vesting eliminates their ability to act as contingent payments, but that need not be the case. Even if pensions are fully vested, workers will lose a premium in defined benefit plans, because pension payments are a function of the higher income levels that would result prior to normal retirement.

[11] Other implicit contracts models incorporate pensions in a life-cycle context. Hu (1989) suggests that firms offer pensions to insure against low consumption states and to elicit efficient turnover. Kahn (1985) also uses pensions as insurance, with low consumption states arising from poor job-match outcomes. Many other implicit contract models don't explicitly include pensions but may be extended to do so if pensions complement an upward-sloping wage profile.

respondents who indicated that they were covered by a pension. The sample we use is restricted to only those workers having defined benefit pensions for which complete pension plan information is available (n=529).[12,13]

The lifetime compensating differences model requires the calculation of the expected present values of wage income and pensions. The pension accruals were based on firm benefit formulas which incorporate firm-specific data on vesting age, Social Security offsets, early retirement provisions, profit sharing and type of annuity. The expected retirement date was based on the worker's response to expected quit date questions (so vesting occurs as long as their expected tenure exceeds the vesting period). In addition, the benefit calculations require a nominal interest rate assumption which we set at the 1982 thirty-year T-Bill rate of 10.85 percent. Expected inflation was assumed to average 6.85 percent in 1982 and real interest rates were 4.00 percent. General wage or productivity growth was assumed to be 2 percent and the inflation and discount rates are the same as those for the pensions' expected present values. For the spot market model, the value of the annual pension accrual is the

[12] We restrict our sample to workers with defined benefit plans because implicit contracts models and pension analysis by Dorsey (1987) suggest that the selection of pension type may be related to firm decisions about the optimal amount of current and future compensation to offer. Since more than 80 percent of all covered workers have defined benefit plans we restrict our analysis to this group. We do not have sufficient data to test hypotheses regarding the nature of the differences between defined benefit and defined contribution plans but a F-test rejects the restriction that the nature of the pension-wage tradeoff is the same in both samples (F=3.034).

[13] We also omit individuals having no pension, because there is likely to be a nonlinear relationship between the probability of pension coverage and the level of benefits. Exploring this full relationship in the context of our structural model (2)-(4), and using instruments in equation (6), is beyond the scope of this paper. Additionally, an F-test can not reject the hypothesis that the decision about whether to provide a pension or not is fundamentally different from that determining the level of benefits (F=5.426). Thus, we do not pool those with zero pensions in with those with positive benefits.

difference in the expected present value of pensions in 1983 minus that in 1982.[14,15] To calculate the wage present value, the wage in 1982 is projected forward and backward using growth rates obtained by regressing wage growth for 1982-85 (given income data from the 1986 Survey of Consumer Finances) as a function of experience and experience squared, with separate regressions for men and women by education group.

The estimates of the hedonic price equation, or pension-wage tradeoff, for the lifetime and the spot market models are presented in Table 1. Standard human capital variables are included in the wage equations to control for worker productivity -- see the variable list in Appendix Table A1. In the lifetime model (columns 1 and 2), we find strong evidence of a significant negative tradeoff between pensions and wages.[16] Moreover, we cannot reject the hypothesis that the pension-wage tradeoff is essentially one-for-one. The spot market model (columns 3 and 4) captures this inverse relationship between wages and pensions but the implied tradeoff is substantially smaller. If we calculate the elasticity of wages with respect to pensions at the mean a one percent increase in pension benefits over the lifecycle has 2.5 times as big as impact as a one percent increase in annual pension accrual.[17] Our results seem to support the

[14] The mean value of the annual pension accrual ($2293 for those having a pension) is comparable to those found by others in the literature (Smith and Ehrenberg, 1983; Moore, 1987).

[15]All dollar variables in the spot market model are deflated by regional CPI to control for regional differences in the cost of living. The results are not sensitive to this deflation.

[16] The nonlinear results indicate that the tradeoff becomes less negative as pension values increase. This result is very consistent with a model in which pensions have substantial fixed costs of provision.

[17]The elasticity with respect to annual pension accrual is -.034 while it is -.086 for lifetime benefits.

equalizing differences theory, and suggest that the wage adjustment tends to take place in a long-term contractual context rather than a spot market basis. Thus, the remaining empirical work focuses on the lifetime model.

Several studies have noted that OLS estimation of the hedonic wage equation may yield biased estimates. Epple (1987) and Biddle and Zarkin (1988) suggest that omitted variable bias may affect the hedonic estimates if there are unobserved productivity factors that are correlated with the hedonic variable:

(6) $\ln W_i = X_i B - b\ p_i + u_i + e_i$

where u_i is an individual-specific intercept. If u_i and p_i are positively correlated, the estimated hedonic coefficient b will be biased upward.

However, in our specification of the HPE it is not possible to sign the direction of this potential omitted variable bias. If pension benefits are a function of wages:

(7) $P_i = \gamma_1 Z_i + \gamma_2 W_i + \gamma_3 W_i^2 + V_i$

where P is the <u>level</u> of the pension benefits, W is wage income, and Z is a vector of other variables that affect pension benefits. Divide equation (7) by W to yield an expression for our pension variable:

(8) $p_i = \gamma_1 Z_i/W_i + \gamma_2 + \gamma_3 W_i + V_i/W_i$

Because increases in W_i affect the pension variable both positively (γ_3) and inversely ($\gamma_1 Z_i$), it is no longer possible to sign the direction of the omitted variable bias imposed by the omission of u_i from equation (6). That is, if the cov(W,u)>0, the cov(u,p) will be positive or negative depending on the relative magnitudes of γ_3 and γ_1 and Z_i.

Smith and Ehrenberg (1983) and Moore (1987) discuss a second problem with the pension variable, arising from the technical bias in firms' pension benefit formulas. Benefits are generally calculated as a function of the worker's wage income in the years just prior to retirement:

(9) $P_i = k\ [E(W_i^f)]$

where annual pension accruals are a positive function of the expected future wages, $E(W_i^f)$, and pension plan generosity, or replacement rate k. Because our pension measure, p, divides the pension level by the wage, the direction of the technical bias is uncertain for the same reason the direction of the omitted variables bias is uncertain.

To test for the possibility of technical bias and omitted variables bias, we instrument p in the wage equation (6) with variables that are unlikely to be correlated with the omitted individual-specific productivity and technical bias. These variables are: pension characteristics (the wage replacement ratio, vesting status); firm-specific characteristics that are likely to be correlated with the generosity of the pension plan (firm size, and we match the 3-digit industry capital-labor ratio from the 1982 Census of Business); and measured individual variables in the wage equation, such as tenure.

The results, in column 5 of Table 1, suggest that the omitted variable bias is positive, but now the b coefficient becomes insignificantly different from zero. However, the increase in the standard errors on the pension variable suggests that the pension-wage tradeoff is now estimated very imprecisely. This suggests that the predicted pension variable is very noisy. The very low R^2 of .25 for the pension equation corroborates this argument.[18] Given this outcome, and the fact that we cannot sign the direction of the bias in the OLS equation based on equation (8), it seems that the loss of efficiency from using poor

[18] These results are available from the authors upon request.

instruments more than offsets the gain from reducing the bias in the OL estimation. Consequently, we believe the OLS estimates of the hedonic equatio are preferable.

As discussed above, to identify the underlying supply and demand function from the market locus requires multi-market data across which the distributio of workers and firms, with given demand and supply functions for pensions, mus vary. As seen in Appendix 2 the mean values of our lifetime pension variabl vary substantially across industries, education groups, and regions. Further in Table 2 we present estimates of the market hedonic with industry, region, an education used as our measure of markets in columns (1)-(3) respectively. F-tests strongly reject the hypothesis that the pension-wage tradeoff locus is th same across these measures of markets.[19] Thus, these results suggest that we ma be able to identify the underlying supply and demand functions using these marke indicators. As noted earlier, identification requires that the market decisio be exogenous to the pension-wage decision. It is very likely that pension deman and investment in education are not simultaneously determined. It also seem reasonable to assume that the costs of pensions or the distribution of worker with tastes for deferred compensation would vary across industries and regions, but that industry or regional choice is independent of pension preferences. Since it is not possible to test for exogeneity explicitly, and since the fit of these equations are about the same, we estimated the supply and deman function using each of these market indicators.

[19]The F-statistic for the industry, region, and education markets in the HPI regressions are F(10,519)=3.336; F(6,523)=2.228; and F(6,523)=3.104, respectively.

In Table 3 we present the results of estimating the HPE and the supply ar demand parameters using nonlinear 3SLS. In columns (1)-(3) the market indicat is industry while in columns (4)-(6) we use education groups.[20] Unlike previou attempts to estimate the underlying demand and supply functions for pension our estimated supply and demand equations contain the response to the implic price of pensions, q.[21] The pension demand is also expressed as a function the worker's age, sex, marital status, number of children, marginal income ta rate, whether the spouse has a pension (SPEN), and net assets (NASSETS). Th supply of pensions by firms is a function of whether the worker is unionize the size of the firm (FSIZE), the firm's K/L ratio, and the FICA tax rate.

The results in Table 3 are robust across market indicators and suggest tha the demand for pensions is positively and significantly related to a worker' age and assets. The age effect is particularly strong as seen by the fact tha the elasticity of demand for pensions (relative to wages) associated with workers age is between 1.09 and 2.34. A firm's willingness to supply pensio increases with its size and capital/labor ratio, the effective FICA tax rat and increases weakly with unionization. None of these effects are particular large – a one percent increase in firm size increases the supply of pensions at most .11 percent. The coefficient on the implicit price of pensions in t supply equation is negative and significant at the five percent level. Althou this implicit price effect appears paradoxical, recall that the implicit pri

[20]The region results are qualitatively similar and are available up request from the authors. A second method identifies the HPE by functional for adding a cubic pension variable, but this variable is found to be insignifican Thus, the quality of the structural demand and supply equations hinges on one belief that industries identify separate exogenous markets for pensions, but test can confirm this assumption.

[21] See Woodbury (1983).

q is calibrated so that increases in this price will lower the pension-wage tradeoff -- or increasing q makes pensions more costly to firms. Thus, the effects of the implicit price variable are consistent with a priori expectations. The demand side coefficient, however, consistently has the wrong sign in all of the market formulations we estimated.

The magnitude of the own price effects can be calculated as elasticities at sample means with respect to the implicit price. In equation (2) a one percent increase in the implicit price of pensions increases the supply (relative to wages) by .16 percent. To put this elasticity into perspective, recall that the mean ratio of lifetime pensions to wages is .058. Thus, a ten percent increase in the price of pensions would cause firms to increase their offered pension-wage ratio from .058 to .059. Thus, the supply of pensions does not appear to be very sensitive to changes in the implicit price. These structural results suggest that policies that shift the demand for pensions and therefore alter the implicit price will have limited impact on the share of compensation firms offer in the form of pensions.

Kahn and Lang (1987) suggest that the estimates in this multi-market model may be sensitive to misspecification because of the cross equation restrictions we impose. They suggest that a specification check could exploit the assumption that the residuals follow the heteroscadastic structure implied by solving equations (3)-(5) in our model. We performed White's (1980) test for heteroskedasticity and could not reject the null hypothesis that the full model was correctly specified and the resultant errors are homoscedastic. Thus, it would appear that the results are not biased by our functional form assumptions.[22]

V. Conclusion

Using a very rich individual data set, the Survey of Consumer Finances for 1983, we find a large and significant compensating differential between the expected present values of wages and pensions for a random sample of workers with defined benefit pensions. The magnitude of the estimated differential implies a one-for-one pension-wage tradeoff over a worker's lifetime. Previous researchers have found little evidence of a compensating differential between pensions and wages, possibly because of the poorer quality of their data. More importantly, our results suggest that this failure was a result of their use of a spot market model requiring period by period tradeoffs of wages for pensions. Our spot market estimates produce a compensating differential of less than a quarter the size of the lifetime tradeoff. Thus, we find strong support for a substantial pension-wage tradeoff that suggests that the underlying structure of the labor market is one of long-term implicit contracts.

Given our lifetime compensating differentials estimates, we also present estimates of the underlying demand and supply equations for pensions. Assuming that industry differences in the implicit cost of pensions reflect different markets for pensions, we use nonlinear three-stage least squares estimation to identify the structural parameters. We find that the demand for pensions rises significantly with a worker's age and assets and the supply rises with firm size

[22]The test statistics for the HPE, demand and supply equations when education is used is the market indicator are 27.40, 5.386 4.488. These are distributed as χ^2 with 231, 55 and 28 degress of freedom, respectively.

and FICA tax burden. We also find that the supply of pensions is a significant function of the implicit price of pensions. These results are especially important for their corroboration of the underlying structure assumed by the hedonic compensating differentials model, but not previously tested.

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Table 1: OLS Results
Hedonic Price Equation

Dependent Variable:

Variable	(1) Log of Lifetime Wages	(2) Log of Lifetime Wages	(3) Log of Annual Wages	(4) Log of Annual Wage	(5) Log of Lifetime Wages
INTERCEPT	2.525	2.587	0.129	0.196	2.66
	(.587)	(.586)	(.527)	(.525)	(.596)
PENS	-.796	-1.57	-0.093	-0.338	-2.10
	(.279)	(.467)	(.054)	(.110)	(1.35)
PENS2	---	1.637	---	0.077	1.76
		(.802)		(.030)	(3.54)
EDUC	.049	.049	0.049	0.052	.050
	(.010)	(.010)	(.010)	(.009)	(.010)
AVETEN**	.096	.104	0.096	0.009	.104
	(.022)	(.022)	(.021)	(.009)	(.027)
AVETEN2**	-.002	-.002	-0.002	-0.0001	-.002
	(.001)	(.001)	(.001)	(.0002)	(.001)
SEX	.321	.311	0.321	0.321	.302
	(.041)	(.042)	(.041)	(.037)	(.044)
RACE	.066	.066	0.066	0.073	.070
	(.046)	(.046)	(.046)	(.042)	(.047)
UNION	.001	.004	0.001	0.010	.010
	(.037)	(.036)	(.037)	(.033)	(.037)
AVEEXP**	.036	.036	0.036	0.015	.038
	(.015)	(.015)	(.015)	(.009)	(.015)
AVEEXP2**	-.001	-.001	-0.001	-0.0003	-.001
	(.0003)	(.0003)	(.0003)	(.0002)	(.0003)
HOURS	.993	.984	.993	1.033	.974
	(.065)	(.066)	(.065)	(.061)	(.067)
R2	.616	.618	.581	.581	.627
N=529					

*Note: Standard errors are in parentheses. All regressions include 4 occupatio
controls.
**The 1982 annual values of these variables and Pen(2) are used when th
dependent variable is annual wages.

Table 2:
OLS Hedonic Market Model Equations

Dependent Variable: Log of PV Wages

Variable	(1) Industry Markets	(2) Regional Markets	(3) Education Markets
INTERCEPT	3.177 (.585)	2.23 (.583)	1.963 (.596)
EDUC	.056 (.01)	.048 (.010)	.086 (.013)
AVETEN	.096 (.021)	.114 (.022)	.106 (.022)
AVETEN2	-.002 (.001)	-.003 (.001)	-.002 (.001)
SEX	.232 (.046)	.289 (.041)	.289 (.041)
RACE	.022 (.046)	.044 (.047)	.052 (.046)
UNION	.019 (.037)	-.020 (.037)	.015 (.036)
AVEEXP	.036 (.015)	.033 (.015)	.042 (.015)
AVEEXP2	-.001 (.0003)	-.001 (.0003)	-.001 (.0003)
HOURS	.918 (.066)	.981 (.066)	.985 (.065)
MKT1*PENS	4.527 (9.13)	-1.196 (1.057)	4.099 (2.45)
MKT1*PENS2	-82.03 (278.8)	6.025 (9.11)	-39.479 (36.05)
MKT2*PENS	1.77 (1.07)	-2.021 (.679)	-.665 (.626)

Table 2 cont'd

Variable	(1)	(2)	(3)
MKT2*PENS2	-4.44	3.947	1.278
	(2.67)	(1.93)	(1.83)
MKT3*PENS	5.34	-5.49	-5.749
	(2.69)	(1.48)	(1.73)
MKT3*PENS2	-128.2	45.015	41.347
	(54.5)	(20.68)	(23.30)
MKT4*PENS	-181.4	-2.099	-3.971
	(158.6)	(1.07)	(1.091)
MKT4*PENS2	1.78	12.144	16.784
	(4.79)	(8.59)	(7.62)
MKT5*PENS	-4.05	12.144	---
	(.841)	(8.59)	
MKT5*PENS2	19.64	---	---
	(6.68)		
MKT6*PENS	-1.36	---	---
	(1.70)		
MKT6*PENS2	15.16	---	---
	(17.85)		
R2	.640	.626	.632
N=529			

*Note: Standard errors are in parentheses. See Appendix 1 for definitions of variables in columns (1), (2) and (3). MKT is defined as INDUS 1-6, REG 1-4 and EDUC 1-4 respectively.

Table 3: Structural Equation Estimates

	Industry Markets			Education Markets		
	(1) HPE	(2) SUPPLY	(3) DEMAND	(4) HPE	(5) SUPPLY	(6) DEMAND
INT	3.190 (.581)	.030 (.010)	-.011 (.012)	1.933 (.60)	.018 (.009)	.0002 (.018)
EDUC	.056 (.009)			.085 (.013)		
TENURE	.095 (.021)			.105 (.022)		
TENSQ	-.002 (.001)			-.002 (.001)		
SEX	.236 (.043)		-.006 (.006)	.292 (.042)		-.018 (.006)
RACE	-.026 (.046)			.042 (.047)		
UNION	.018 (.036)	.0055 (.0056)		.006 (.037)	.006 (.006)	
AVEEXP	.035 (.015)			.046 (.015)		
AVEEXP2	-6X10 (3X10)			-.001 (.0003)		
HOURS	.924 (.065)			.990 (.065)		
PENS*MKT1	3.570 (2.13)			3.99 (2.27)		
PENS2*MKT1	-61.504 (90.104)			-40.45 (35.5)		
PENS*MKT2	1.716 (1.03)			-.694 (.649)		
PENS2*MKT2	-4.681 (2.580)			1.01 (1.87)		
PENS*MKT3	3.393 (1.622)			-4.60 (1.72)		
PENS2*MKT3	-93.495 (36.056)			27.99 (22.9)		
PENS*MKT4	4.005 (1.897)			-4.453 (1.101)		
PENS2*MKT4	-261.82 (83.021)			18.922 (7.68)		

Table 3 cont'd

	(1)	(2)	(3)	(4)	(5)	(6)
PENS*MKT5	-3.824 (.797)					
PENS2*MKT5	16.413 (6.379)					
PENS*MKT	-3.207 (1.059)					
PENS2*MKT6	36.962 (13.80)					
q		-.008 (.002)	-.007 (.001)		-.002 (.001)	-.003 (.001)
AGE			.0014 (.0003)			.002 (.0003)
NASSETS			$4.97X10^{-8}$ ($2.61X10^{-8}$)			$4X10^{-8}$ ($2X10^{-8}$)
MARRIED			.004 (.007)			.002 (.008)
CHILD			$-2.15X10^{-4}$ (.002)			-.00002 (.003)
SPEN			$-9.14X10^{-7}$ ($1.95X10^{-6}$)			$1X10^{-5}$ ($2X10^{-5}$)
TAX		.184 (.115)	-.020 (.029)		.430 (.117)	-.047 (.032)
KL		$5.78X10^{-8}$ ($5.96X10^{-6}$)			$8X10^{-8}$ ($4X10^{-6}$)	
FSIZE		$7.41X10^{-5}$ ($3.61X10^{-5}$)			$6X10^{-5}$ ($4X10^{-5}$)	
R^2	.655	.162	.176	.645	.055	.0928
SSE	74.05	1.95	1.83	76.20	2.104	1.936

*Note: NL3SLS results for the HPE, demand or supply equations where supply fixed (Col. 3 & 6) and demand is fixed (Col. 2 & 5). The HPE (Col. 1 & includes controls for occupation groups as well. TAX1 is used in columns 2 a 5 while TAX2 is used in columns 3 and 6. Standard errors are in parentheses

Appendix 1

VARIABLE	LABEL	MEAN	STANDARD DEVIATION
PVWAGE	Present value of wages	393918.197	246595.55
PVPENS	Present value of pension	20017.814	22506.008
YRWAGE	annual earnings in 1982	15097.715	8370.294
PENSION	change in pension accrual between 1983-82	1405.611	4707.981
PENS(1)	PVPENSION/PVWAGE	.058	.065
PENS(2)	pension/yrwage	0.102	0.303
AVETEN	average tenure**	14.782	4.926
AVEEXP	average experience**	21.821	7.49
EDUC	level of education	13.429	2.641
UNION	=1 if in union member	0.497	0.500
HOURS	log avg. annual hours working	7.588	0.273
SEX	=1 if male	0.601	0.490
RACE	=1 if white	0.824	0.381
OCC1	=1 if professional or management	0.389	0.488
OCC2	=1 if technical, sales or clerical	0.250	0.433
OCC3	=1 if services	0.085	0.279
OCC4	=1 if manufacturing or trades	0.270	0.445
OCC5	=1 if occup is forestry or farming	0.006	0.075
KL	gross depreciable assets/employees*	407.358	780.998
FSIZE	3-digit industry level: number of employees per establishment*	89.425	91.308
INDUS1	=1 if mining, construction	0.045	0.208
INDUS2	=1 if manufacturing	0.231	0.422
INDUS3	=1 if transportation	0.117	0.322
INDUS4	=1 if trades, FIRE	0.085	0.279
INDUS5	=1 if services	0.363	0.481
INDUS6	=1 if government	0.159	0.366

Appendix 1 cont'd

VARIABLE	LABEL	MEAN	STANDARD DEVIATION
RRATIO	replacement ratio for final year	16.104	14.669
VESTED	=1 if vested in 1982	0.894	0.308
CHILD	number of children	1.193	1.211
TAX(1)	marginal income tax rate	0.298	0.105
TAX(2)	FICA marginal tax rate	0.056	0.025
AGE	age of worker in 1982	45.223	9.603
SPEN	1982 value of spousal pension	292.747	1403.271
NASSETS	net financial assets for family	55939.492	74445.237
MARRIED	=1 if married	0.788	0.409
REG1	=1 if resident of northeast	0.246	0.431
REG2	=1 if resident of north central	0.268	0.444
REG3	=1 if resident of south	0.333	0.472
REG4	=1 if resident of west	0.153	0.360
EDUC1	=1 if less than 12 yrs. education	.138	.345
EDUC2	=1 if 12 years education	.355	.479
EDUC3	=1 if greater than 12 yrs but less than 16 years education	.189	.392
EDUC4	=1 if greater than or equal to 16 years education	.318	.466

Appendix 2

Mean Value of Pension/Wage Variables by Market

Education	Means	Region	Means	Industry	Means
< 12 years	.047	Northeast	.054	Mining/ Construction	.025
= 12 years	.057	Northcentral	.057		
< 16 years	.053	South	.057	Manufacturing	.036
≥ 16 years	.067	West	.069	Transportation	.039
				Trade/Fire	.027
				Services	.079
				Government	.084